Profibus

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PROFIBUS (Process Field Bus) is a standard for field bus communication in automation technology and was first promoted (1989) by BMBF (German department of education and research). It should not be confused with the PROFINET standard for industrial Ethernet.

PROFIBUS Protocol Information	
Type of Network	Device Bus, Process Control
Physical Media	Twisted pair, fiber
Network Topology	Bus
Device Addressing	DIP Switch or hardware/software
Governing Body	PROFIBUS&PROFINET International (PI)
Website	www.profibus.com (http://www.profibus.com/)

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Profibus electrical connector

Origin

The history of PROFIBUS goes back to a publicly promoted plan for an association started in Germany in 1987 and for which 21 companies and institutes devised a master project plan called "field bus". The goal was to implement and spread the use of a bit-serial field bus based on the basic requirements of the field device interfaces. For this purpose, respective company members agreed to support a common technical concept for production and process automation. First, the complex communication protocol Profibus FMS (Field bus Message Specification), which was tailored for demanding communication tasks, was specified. Subsequently in 1993, the specification for the simpler and thus considerably faster protocol PROFIBUS DP (Decentralized Peripherals) was completed. It replaced FMS.

Use

There are two variations of PROFIBUS; the most commonly used DP, and the lesser used PA variations:

- **PROFIBUS DP** (Decentralized Peripherals) is used to operate sensors and actuators via a centralized controller in production technology. The many standard diagnostic options, in particular, are focused on here. Other areas of use include the connection of "distributed intelligence", i.e. the networking of multiple controllers to one another (similar to PROFIBUS FMS). Data rates up to 12 Mbit/s on twisted pair cables and/or fiber optics are possible.
- **PROFIBUS PA** (Process Automation) is used to monitor measuring equipment via a process control system in process engineering. This PROFIBUS variant is ideal for explosion-hazardous areas (Ex-zone 0 and 1). Here, a weak current flows through bus lines in an intrinsically safe circuit so that explosive sparks are not created, even if a malfunction occurs.

The disadvantage of this variant is the slower data transmission rate of 31.25 kbit/s.

PROFIBUS is the only field bus that can be used in equal measure in production automation and process automationand has since become a global market leader. Worldwide, over 20 million PROFIBUS devices are in use (as of 2007).

Technology

PROFIBUS Protocol (OSI reference model)

OSI-Layer		PROFIBUS			
7	Application	DPV0	DPV1	DPV2	
6	Presentation				
5	Session				
4	Transport		--		Management
3	Network				
2	Data Link		FDL		
1	Physical	EIA-485	Optical	MBP	

Application layer

To utilize these functions, various service levels of the DP protocol were defined:

- DP-V0 for cyclic exchange of data and diagnosis
- DP-V1 for acyclic and cyclic data exchange and alarm handling
- DP-V2 for isochronous mode and data exchange broadcast (slave-to-slave communication)

Security layer

The security layer **FDL** (Field bus Data Link) works with a hybrid access method that combines token passing with a master-slave method. In a PROFIBUS DP network, the controllers or process control systems are the masters and the sensors and actuators are the slaves.

Various telegram types are used. They can be differentiated by their start delimiter (SD):

No data: SD1 = 0x10

SD1	DA	SA	FC	FCS	ED

Variable length data:

SD2 = 0x68

SD2	LE	LEr	SD2	DA	SA	FC	DSAP	SSAP	PDU	FCS	ED

Fixed length data:

SD3 = 0xA2

SD3	DA	SA	FC	PDU	FCS	ED

Token:

SD4 = 0xDC

Brief acknowledgement:

SC = 0xE5

SD: Start Delimiter

LE: Length of protocol data unit, (incl. DA,SA,FC,DSAP,SSAP)

LEr: Repetition of protocol data unit, (Hamming distance = 4)

FC: Function Code

DA: Destination Address

SA: Source Address

DSAP: Destination Service Access Point

SSAP: Source Service Access Point

SAP (Decimal)	**SERVICE**
Delault 0	Cyclical Data Exchange (Write_Read_Data)
54	Master-to-Master SAP (M-M Communication)
55	Change Station Address (Set_Slave_Add)
56	Read Inputs (Rd_Inp)
57	Read Outputs (Rd_Outp)
58	Control Commands to a DP Slave (Global_Control)
59	Read Configuration Data (Get_Cfg)
60	Read Diagnostic Data (Slave_Diagnosis)
61	Send Parameterization Data (Set_Prm)
62	Check Configuration Data (Chk_Cfg)

Note: SAP55 is optional and may be disabled if the slave doesn't provide non-volatile storage memory for the station address.

PDU: Protocol Data Unit (protocol data)

FCS: Frame Checking Sequence

ED: End Delimiter (= 0x16 !)

The FCS is calculated by simply adding up the bytes within the specified length. An overflow is

ignored here. Each byte is saved with an even parity and transferred asynchronously with a start and stop bit. There may not be a pause between a stop bit and the following start bit when the bytes of a telegram are transmitted. The master signals the start of a new telegram with a SYN pause of at least 33 bits (logical "1" = bus idle).

Bit-transmission layer

Three different methods are specified for the bit-transmission layer:

- With electrical transmission pursuant to EIA-485, twisted pair cables with wave impedances of 150 ohms are used in a bus topology. Bit rates from 9.6 kbit/s to 12 Mbit/s can be used. The cable length between two repeaters is limited to 100 to 1200 m, depending on the bit rate used. This transmission method is primarily used with PROFIBUS DP.
- With optical transmission via fiber optics, star-, bus- and ring-topologies are used. The distance between the repeaters can be up to 15 km. The ring topology can also be executed redundantly.
- With MBP (Manchester Bus Powered) transmission technology, data and field bus power are fed through the same cable. The power can be reduced in such a way that use in explosion-hazardous environments is possible. The bus topology can be up to 1900 m long and permits branching to field devices (max. 60 m branches). The bit rate here is a fixed 31.25 kbit/s. This technology was specially established for use in process automation for PROFIBUS PA.

For data transfer via sliding contacts for mobile devices or optical or radio data transmission in open spaces, products from various manufacturers can be obtained, however they do not conform to any standard.

Standardization

PROFIBUS was defined in 1991/1993 in DIN 19245, was then included in EN 50170 in 1996 and, since 1999, established in IEC 61158/IEC 61784.

Organization

The PROFIBUS Nutzerorganisation e.V. (PROFIBUS User Organization) (PNO) was created in 1989. This group is comprised of manufacturers and users from Germany. In 1992, the first regional PROFIBUS organization was founded (PROFIBUS Schweiz in Switzerland). In the following years, additional RPAs (Regional PROFIBUS & PROFINET Associations) were added. Today, PROFIBUS is represented by 25 RPAs around the world. In 1995, all the RPAs joined together into the international umbrella association PROFIBUS & PROFINET International (PI).

References

- [1] (http://www.profibus.com/pall/meta/downloads/article/00454/) PROFIBUS system description

See also

- Fieldbus
- List of automation protocols

External links

- PROFIBUS & PROFINET International (http://www.profibus.com/)

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